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Anma et al.

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(54) **VESSEL**

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CPC ***F02M 35/10268*** (2013.01); ***B63H 11/04*** (2013.01); ***F02M 35/10124*** (2013.01); ***F04F 5/24*** (2013.01); *B63B 2751/00* (2013.01); *B63B 2758/00* (2013.01)

(58) **Field of Classification Search**

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USPC 440/88; 114/55
See application file for complete search history.

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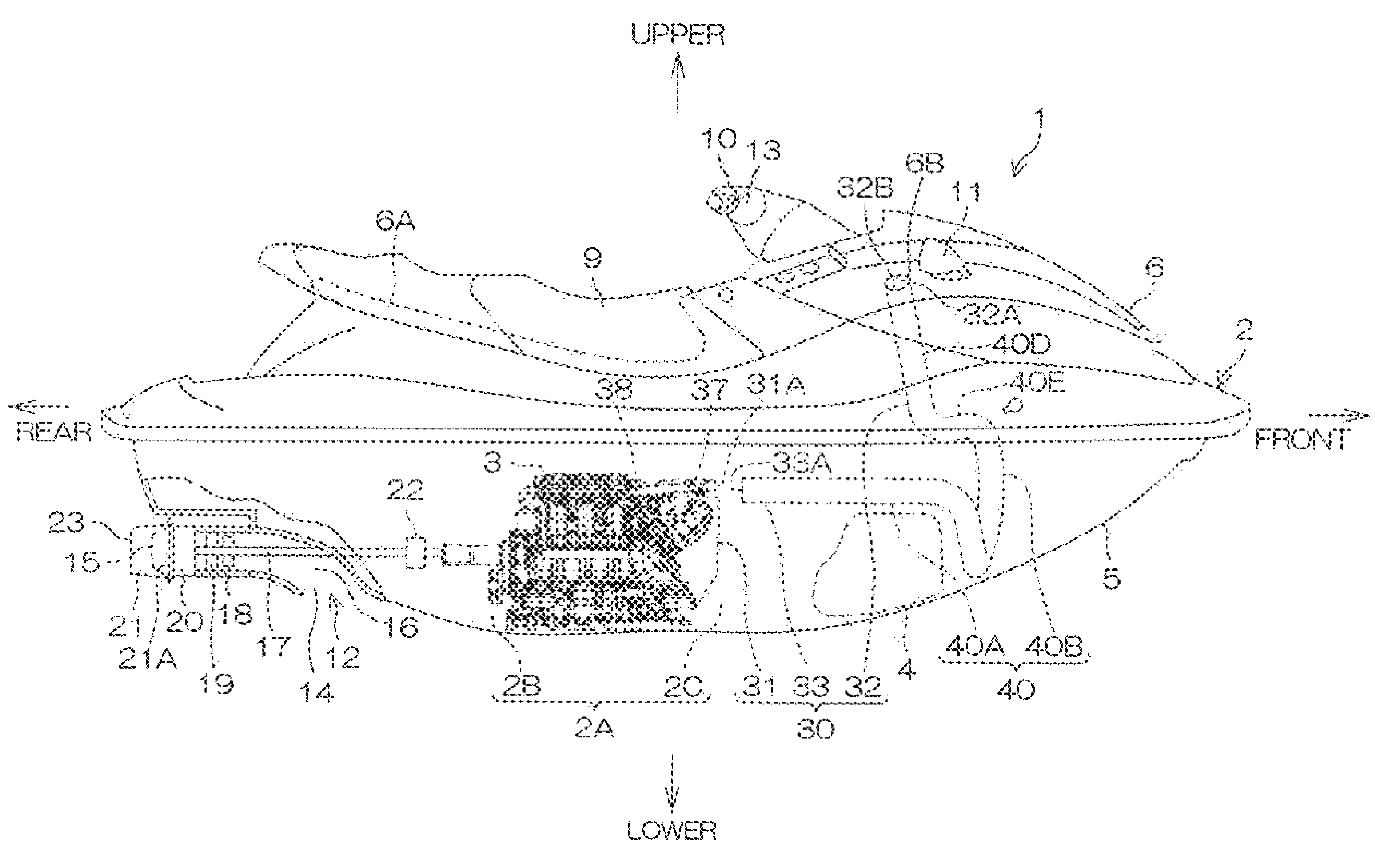
(57) **ABSTRACT**

A vessel includes a vessel body, an engine contained in the vessel body, an air intake box including an air intake port and that is attached to the engine, an air intake duct drawn around in the vessel body, and a guide duct including an opening that opposes the air intake port. The air intake box supplies air taken in from the air intake port to the engine. The air intake duct includes an outer end connected to a deck of the vessel body. The guide duct guides air taken in from outside the vessel body by the air intake duct to the opening.

15 Claims, 13 Drawing Sheets



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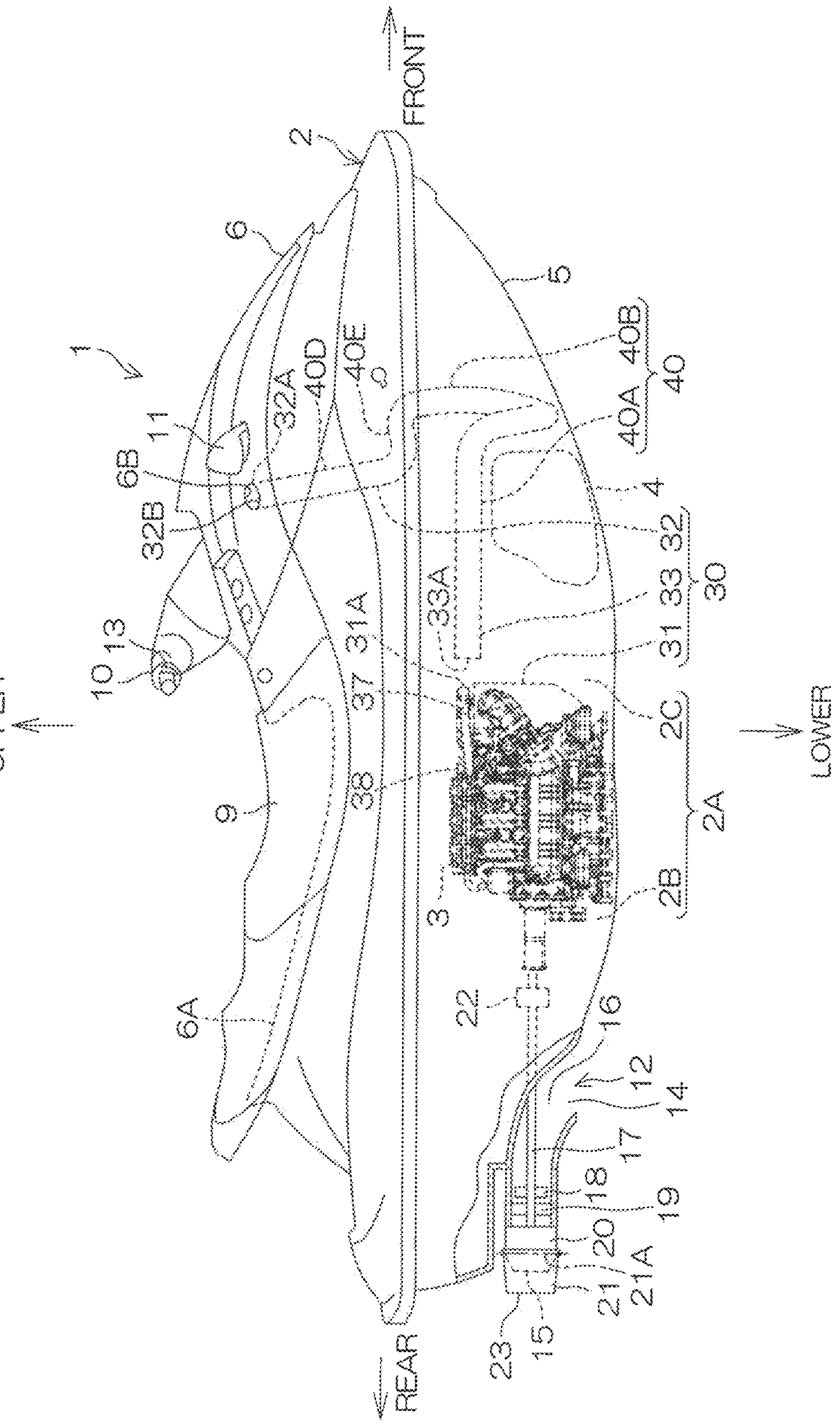
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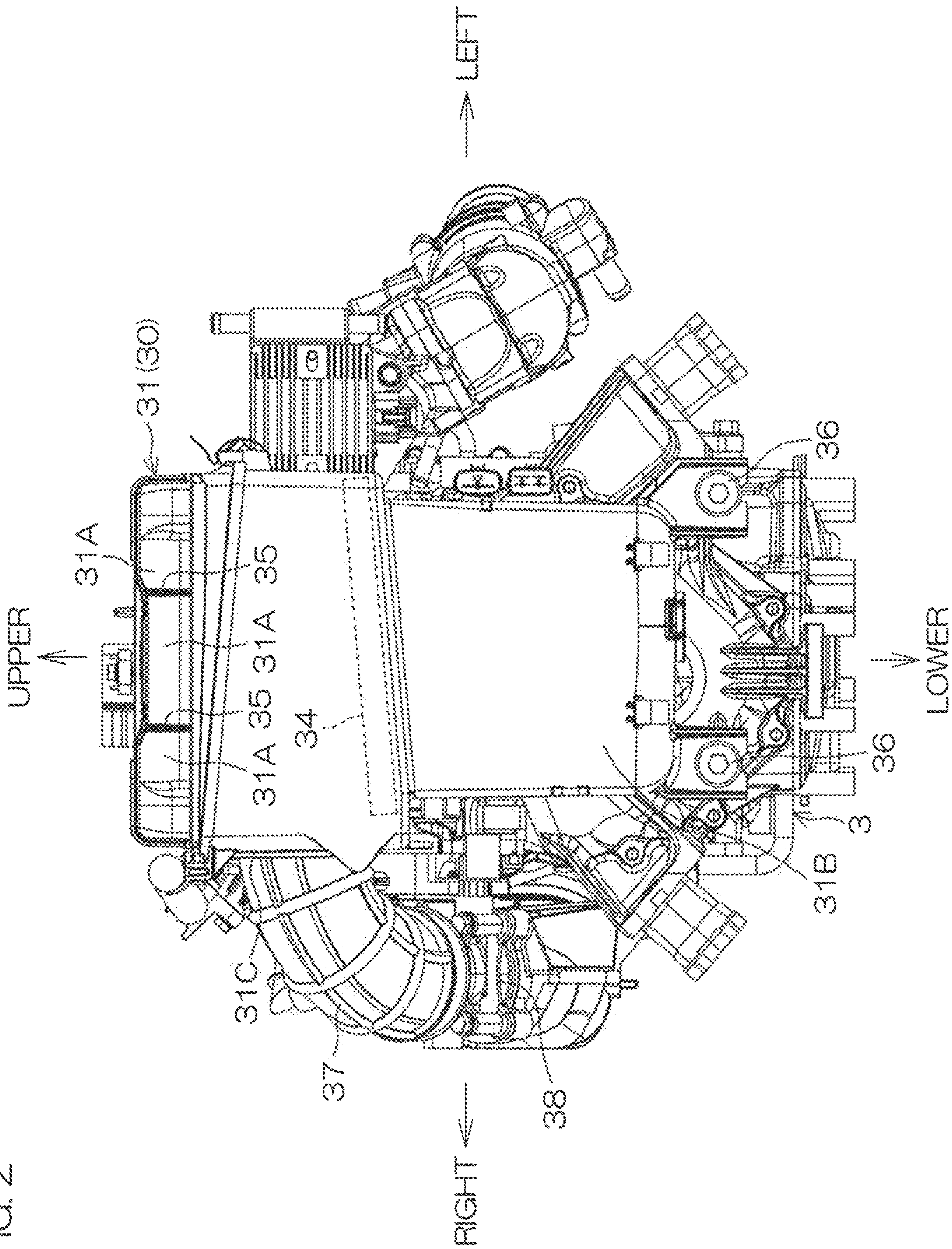
FIG. 1

FIG. 2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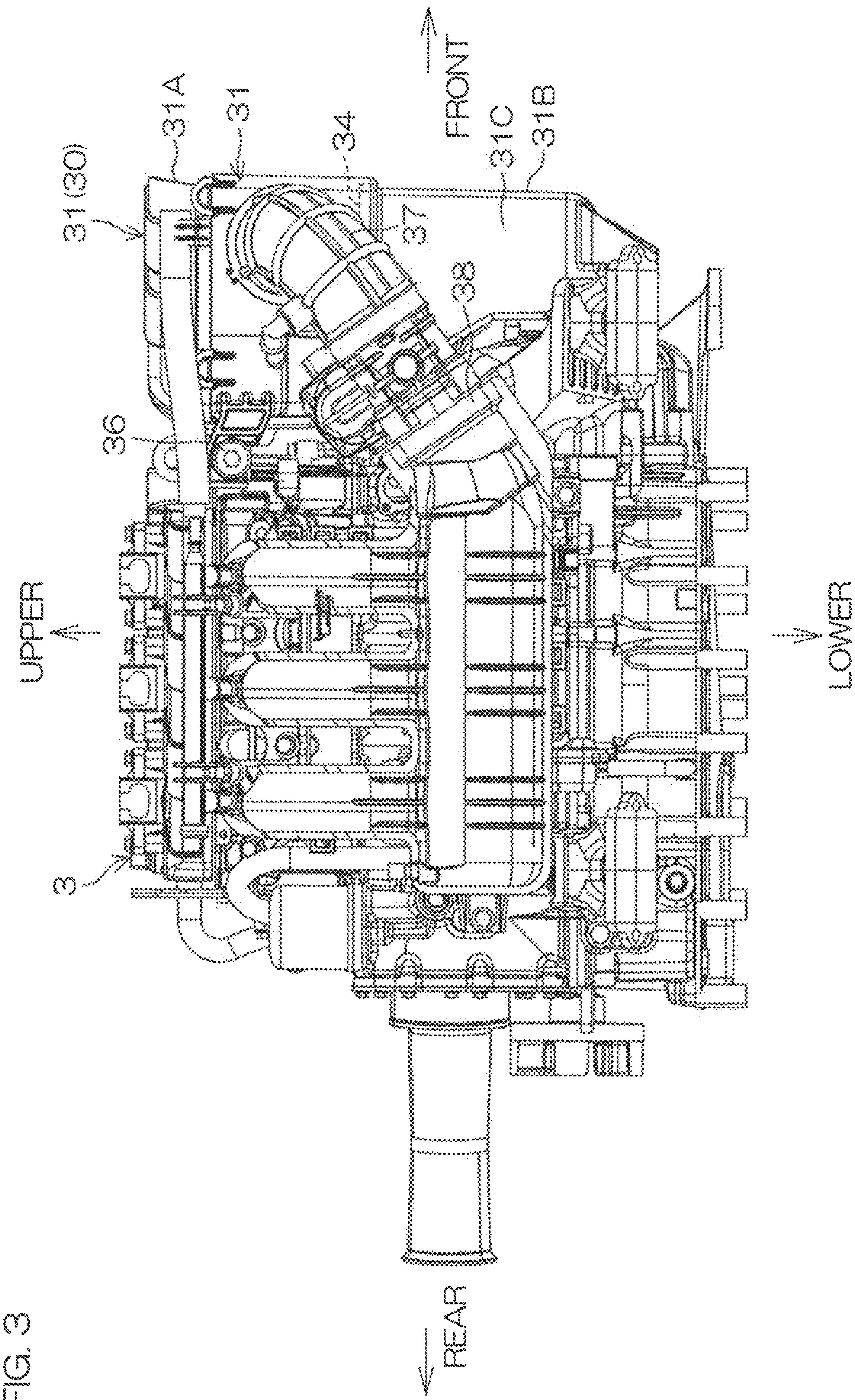
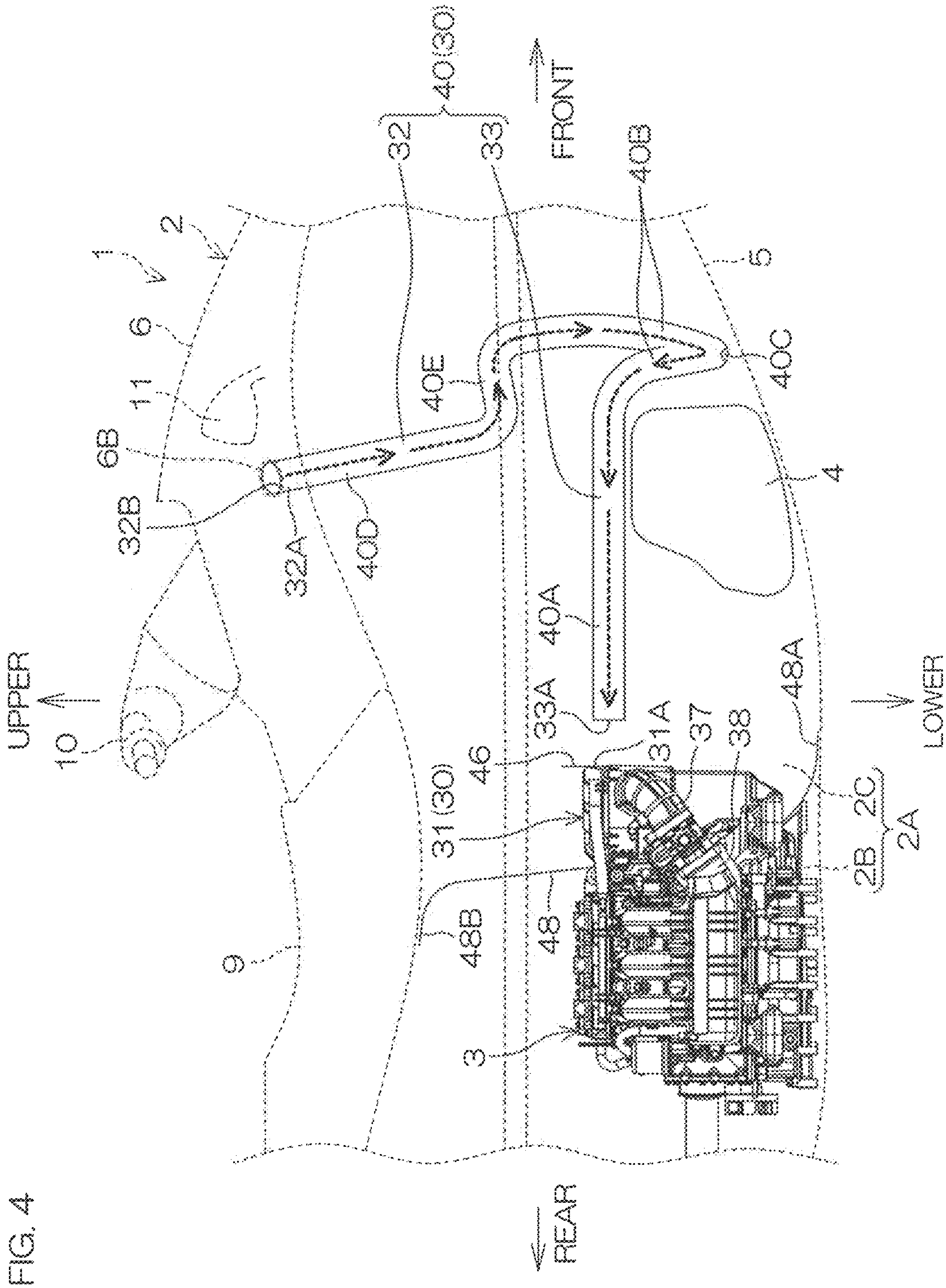


FIG. 3

FIG. 4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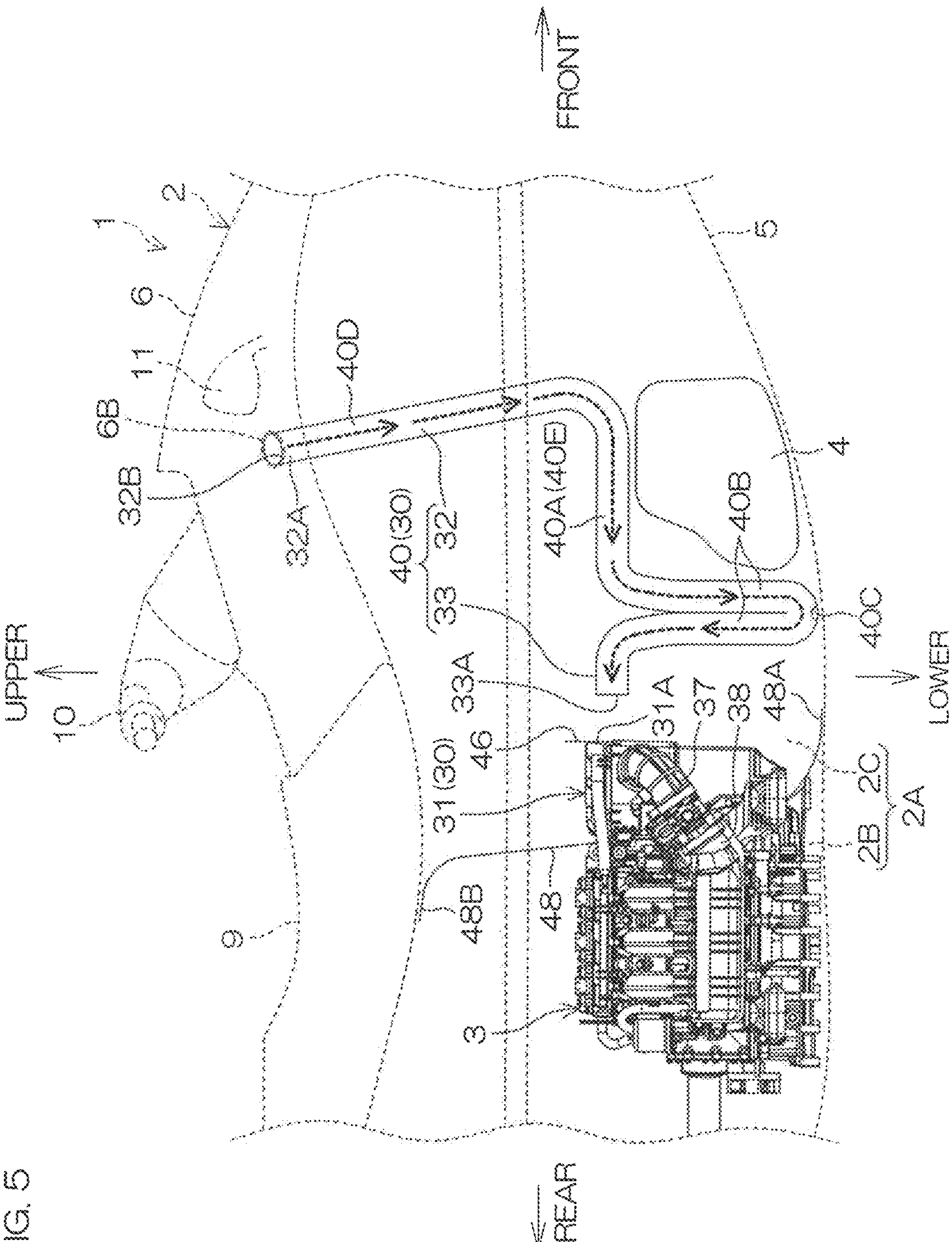
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FIG. 5

FIG. 6

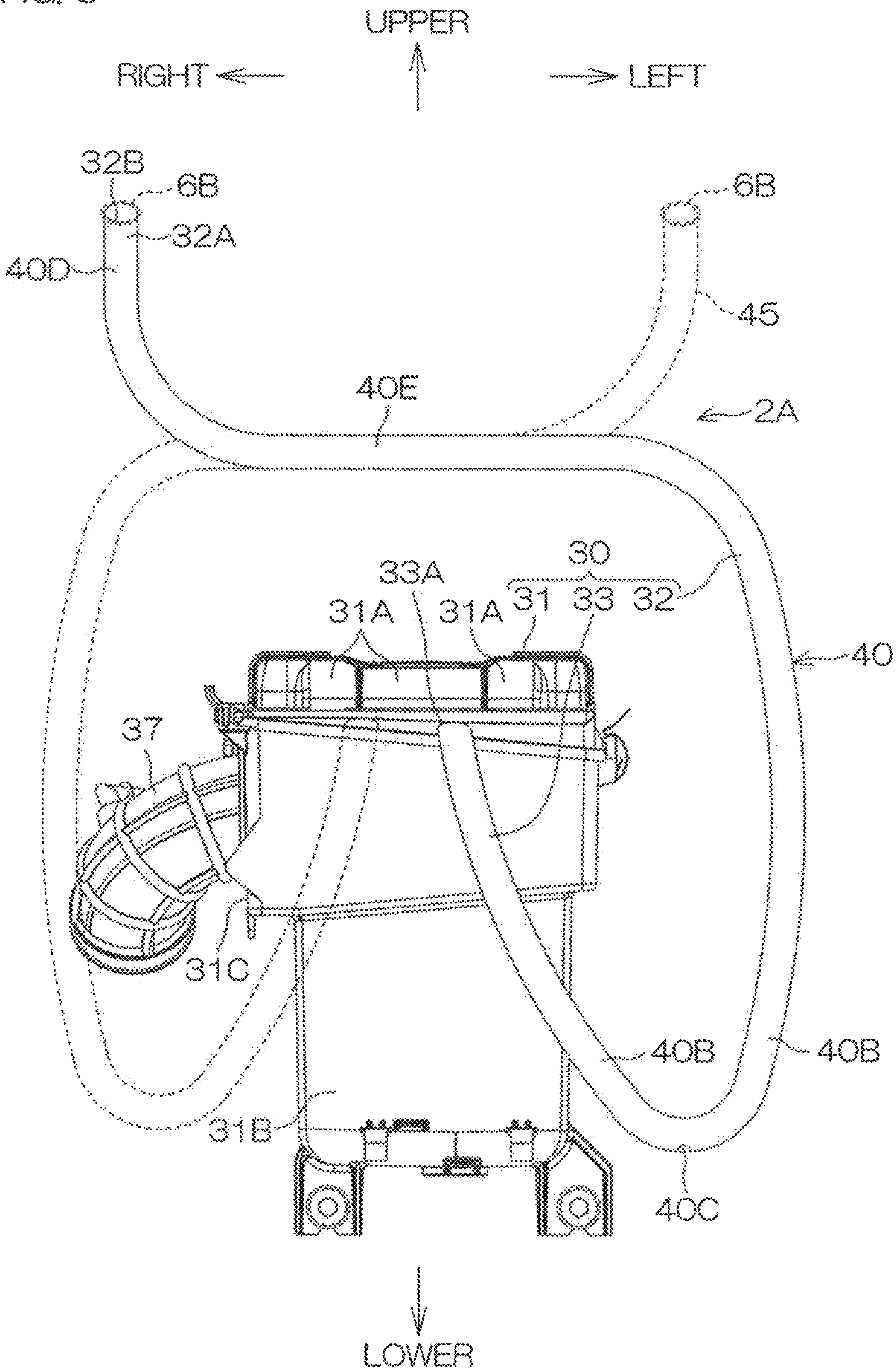

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FIG. 7

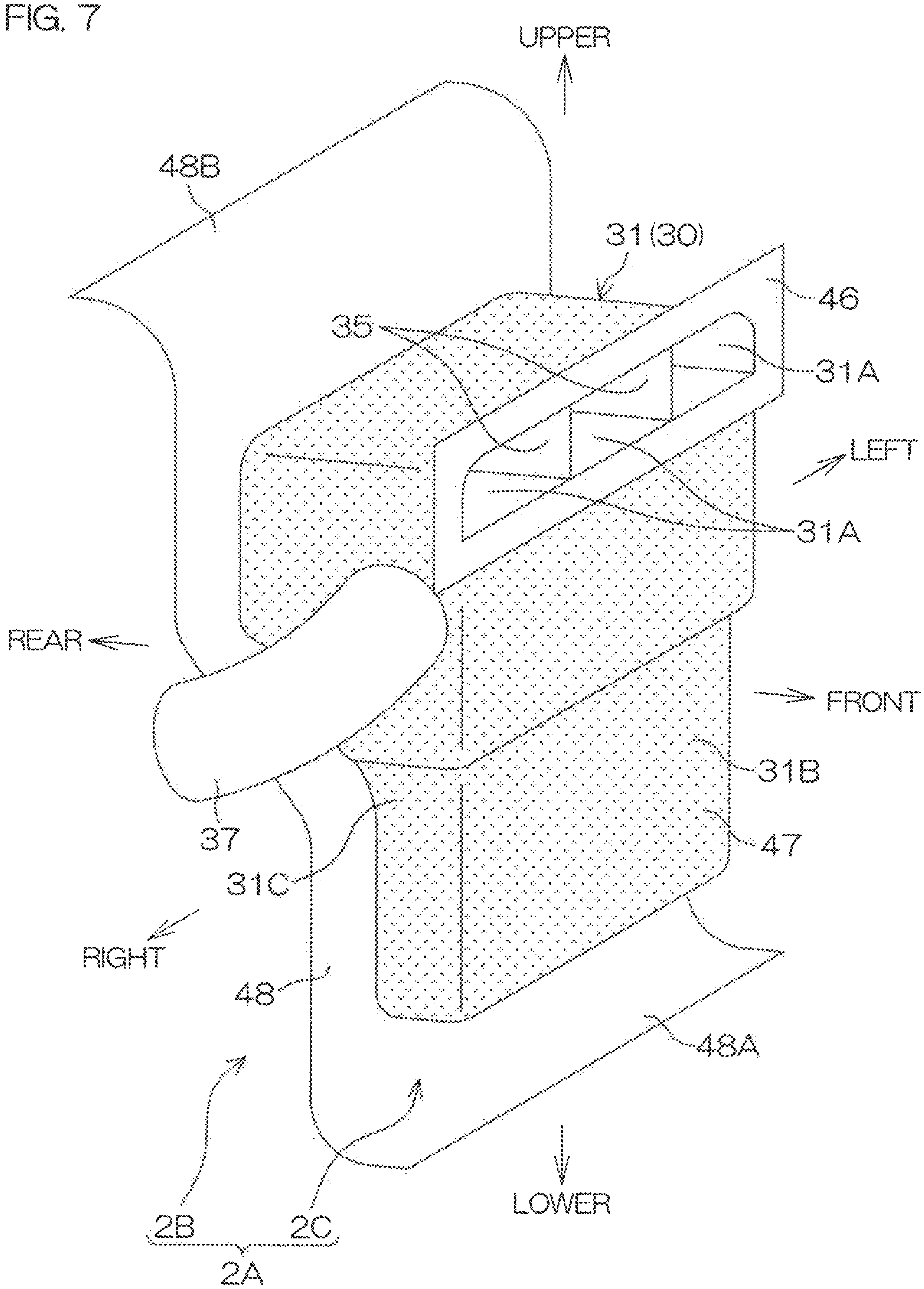
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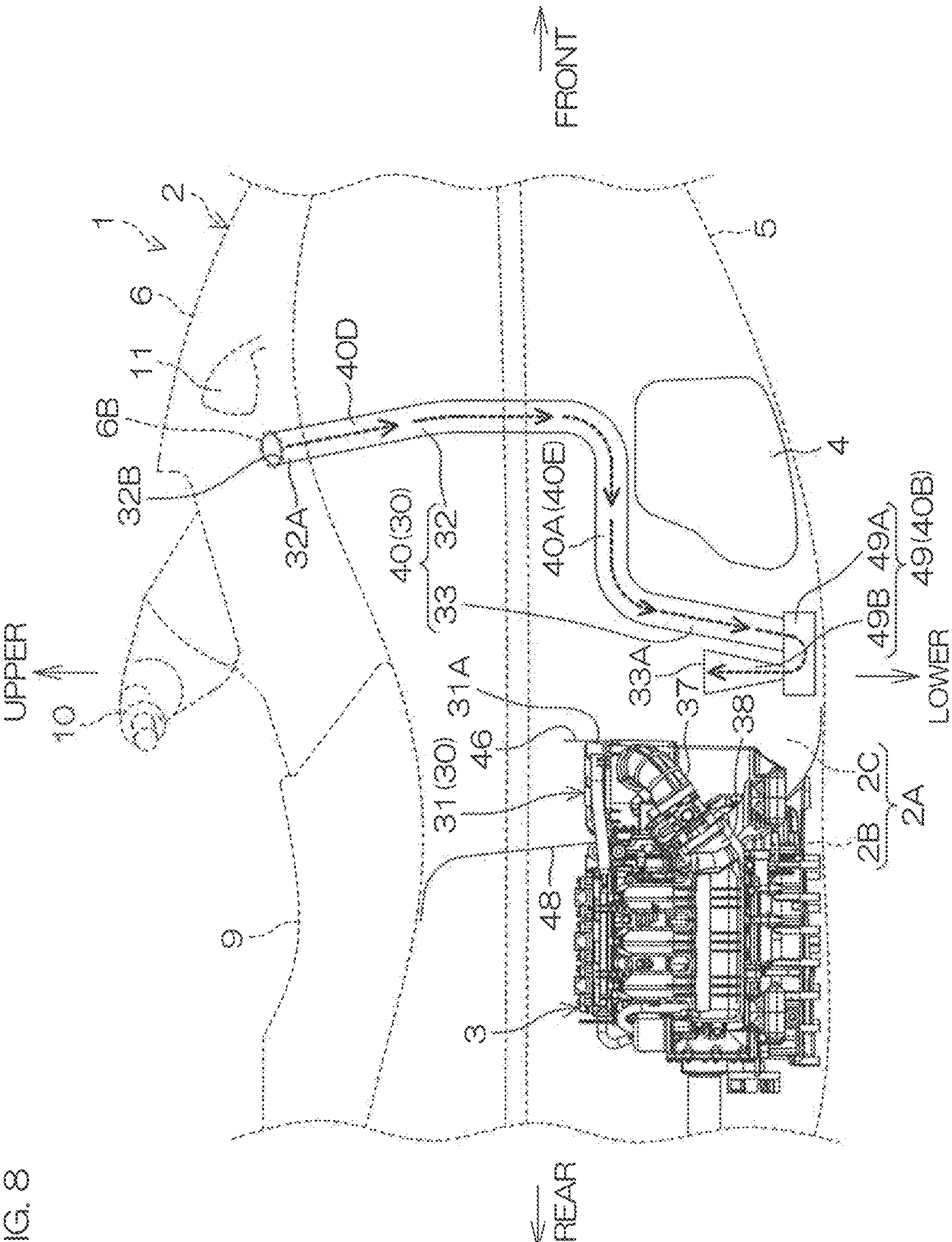
FIG. 8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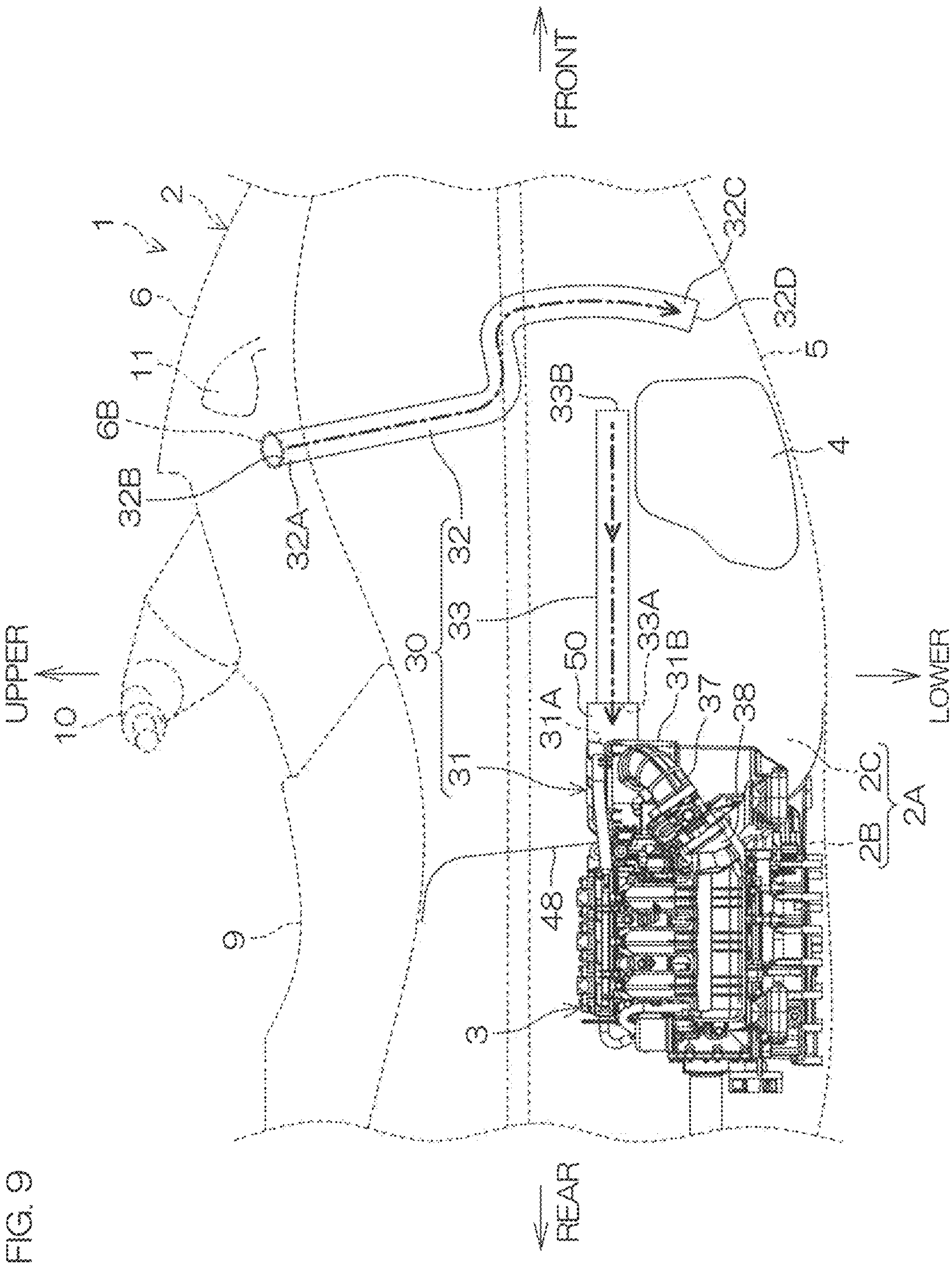
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FIG. 9

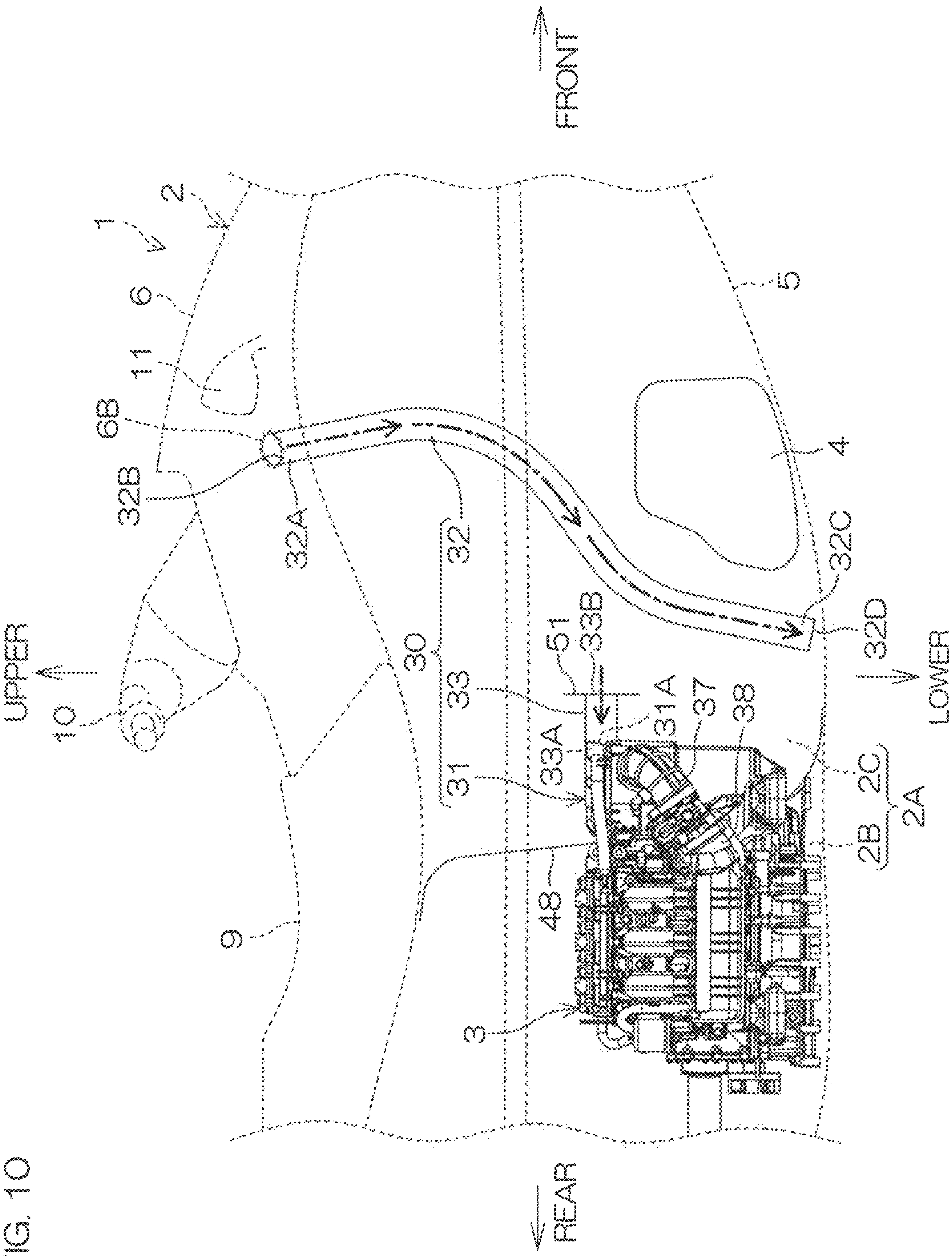
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FIG. 10

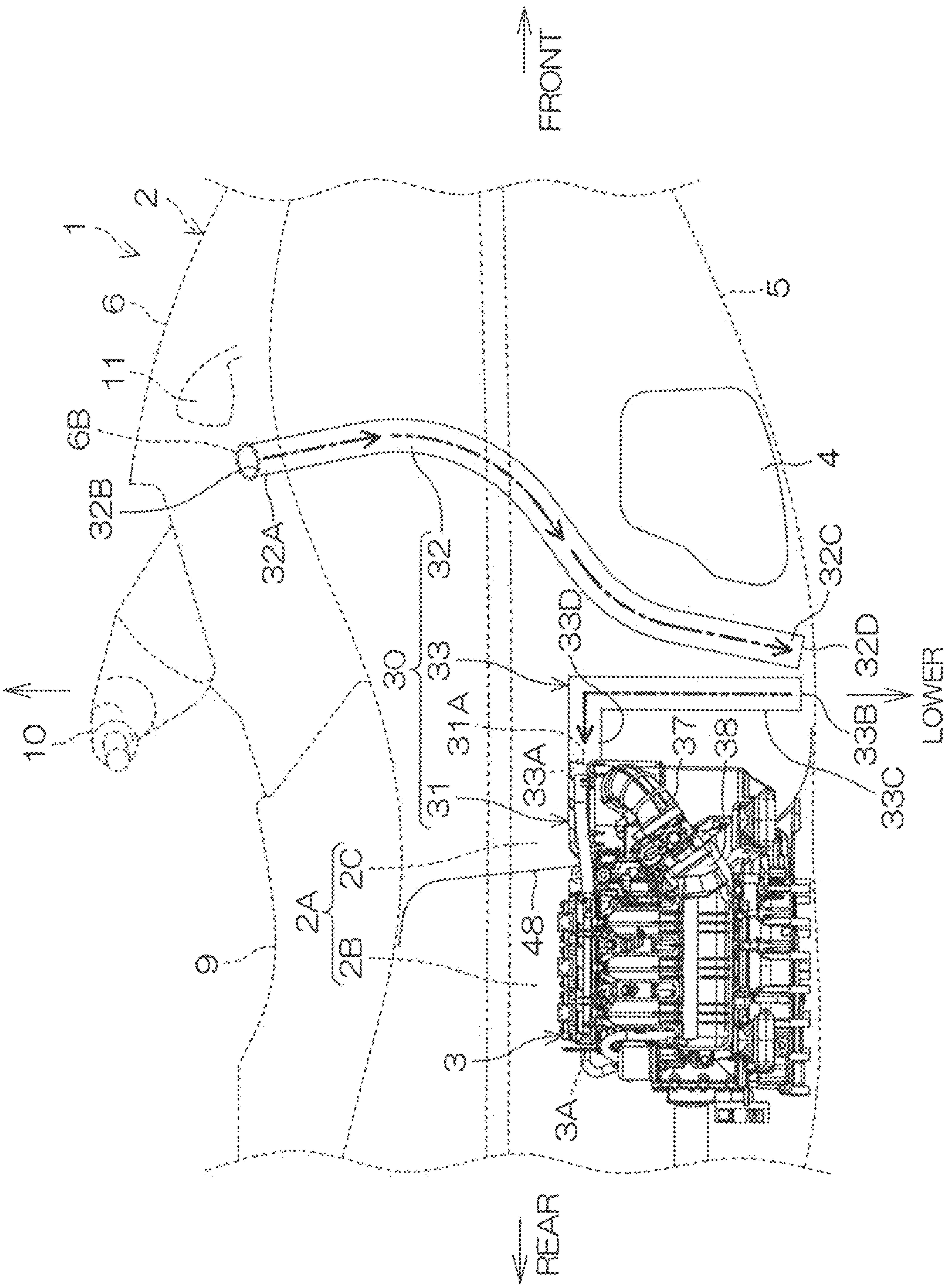
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FIG. 11

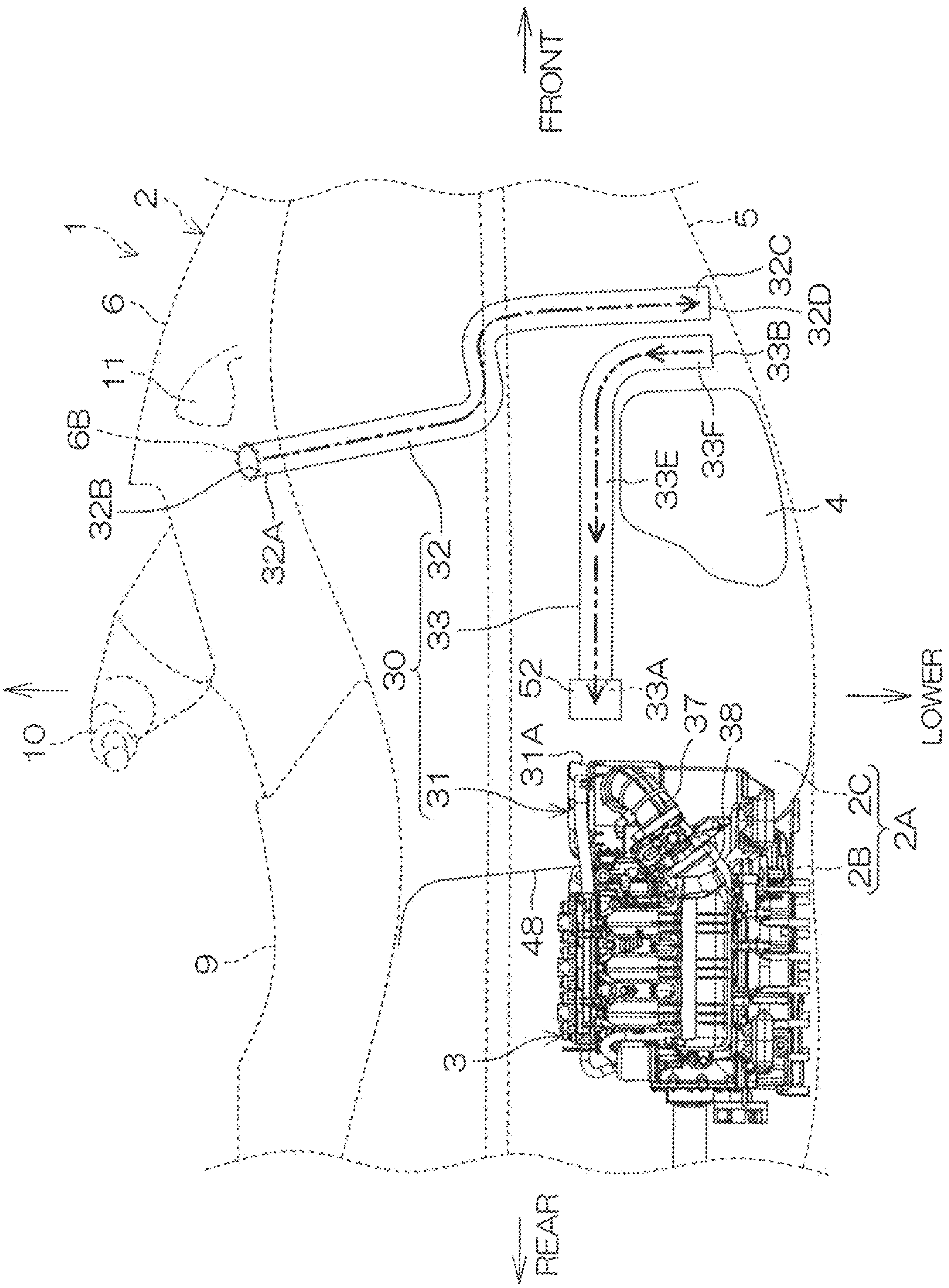
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FIG. 12

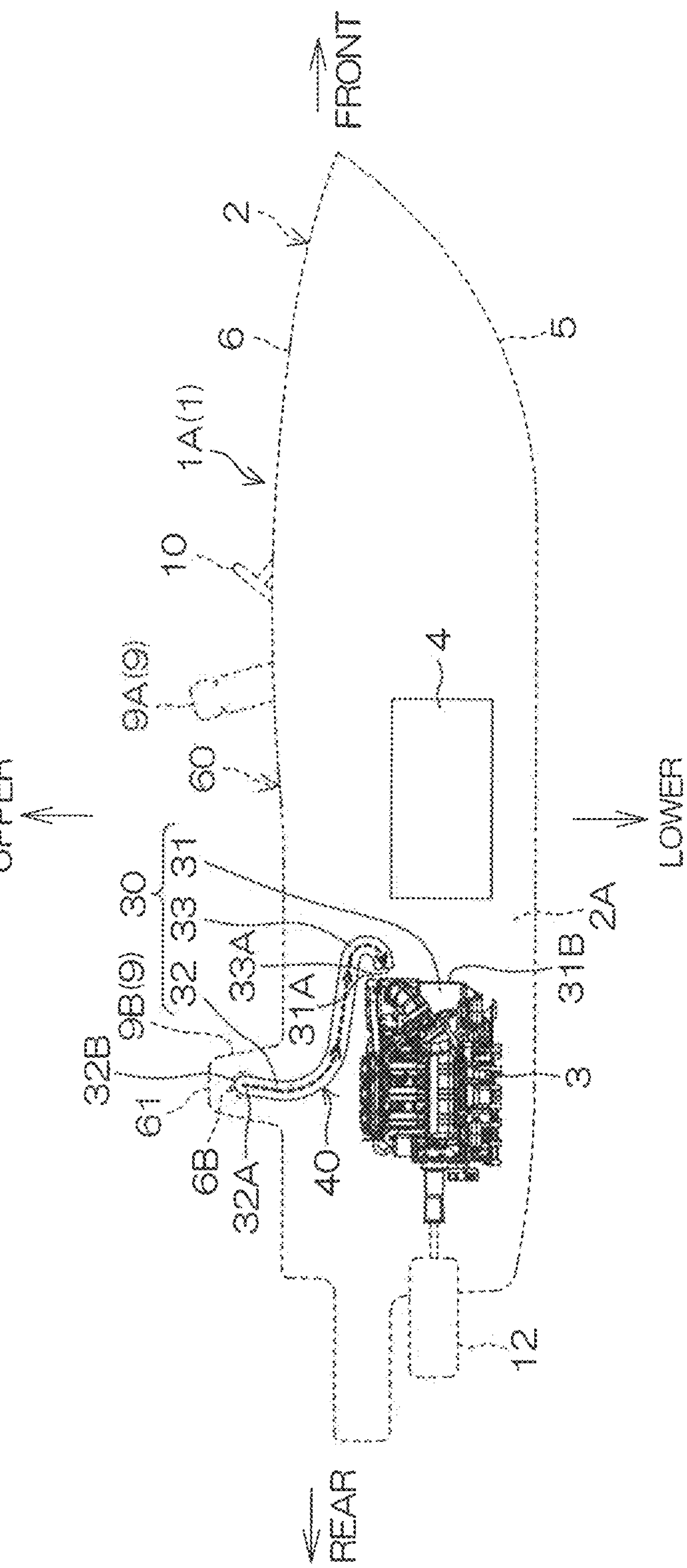
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FIG. 13

VESSEL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vessel including an engine.

2. Description of the Related Art

A small-sized vessel disclosed in Japanese Patent Application Publication No. 2009-220637 includes a vessel body having an inboard space in its inside and a jet pump disposed behind the vessel body. The inboard space contains an engine that drives the jet pump, a fuel tank for the engine, and an air intake duct through which air passes between the inboard space and outside the vessel body. The engine is disposed in front of the jet pump, and the fuel tank is disposed in front of the engine. The air intake duct has its outer end attached to a wall surface of the vessel body and its inner end disposed in the inboard space. The outer end of the air intake duct includes an air intake port that opens outwardly from the vessel body. Air outside the vessel body passes through the air intake duct from the air intake port, and flows into the inboard space from an inner end of the air intake duct, and is then supplied to the engine.

In the small-sized vessel disclosed in Japanese Patent Application Publication No. 2009-220637, the inner end of the air intake duct is disposed at a more forward position than the fuel tank in the inboard space. Therefore, air that has been taken into the air intake duct from outside the vessel body and that has reached the inner end flows from a more forward position than the fuel tank toward the engine disposed behind the fuel tank in the inboard space. However, the inboard space is filled with hot air generated by the engine. Therefore, outside air taken therein through the air intake duct is exposed to the hot air, and is then warmed, and reaches the engine. Therefore, there is a concern that the temperature of the intake air of the engine will increase and, correspondingly, the output of the engine will decrease.

SUMMARY OF THE INVENTION

In order to overcome the previously unrecognized and unsolved challenges described above, preferred embodiments of the present invention provide a vessel including a vessel body, an engine contained in the vessel body, an air intake box attached to the engine, an air intake duct drawn around in the vessel body, and a guide duct. The vessel body includes a hull defining a vessel bottom and a deck disposed above the hull. The air intake box includes an air intake port, and supplies air taken in from the air intake port to the engine. The air intake duct includes an outer end connected to the deck. The guide duct includes an opening that opposes the air intake port, and guides air taken in from outside the vessel body by the air intake duct to the opening.

According to this preferred embodiment, air taken in from outside the vessel body by the air intake duct flows through the inside of the air intake duct, and then flows through the inside of the guide duct, and reaches the opening of the guide duct. The opening opposes the air intake port of the air intake box, and therefore air that has reached the opening swiftly flows into the air intake port. Therefore, air outside the vessel body reaches the air intake port of the air intake box without being exposed to hot air generated by the heat of the engine in the vessel body, and hence is supplied to the engine at a temperature that is substantially no different from the outside air temperature. As a result, it is possible to reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the vessel may include a connector duct in which the air intake duct and the guide duct are integral with each other, and the connector duct may be drawn around in the vessel body so as to pass through an inside of the vessel body from the outer end and so as to oppose the air intake port.

According to this preferred embodiment, the air intake duct and the guide duct are integral with each other, and therefore the intake air temperature of the engine is prevented from being increased while also reducing the number of components.

In a preferred embodiment of the present invention, the vessel may include two ducts that differ from each other in shape, and one of the two ducts may be the connector duct.

In a preferred embodiment of the present invention, the vessel may include a fuel tank that is disposed at a more forward position than the air intake box in the vessel body and that stores fuel for the engine, and the connector duct may include an upper portion disposed at a higher position than the fuel tank and a turned-up portion disposed at a more forward position than the fuel tank or disposed between the air intake box and the fuel tank, the turned-up portion extending downwardly from the upper portion and then turning upwardly.

According to this preferred embodiment, the turned-up portion is positioned at a higher position than a water surface around the vessel body when the vessel is overturned so as to reverse the up-down direction of the vessel body, and therefore water outside the vessel body cannot pass through the turned-up portion even if this water enters into the connector duct. This makes it possible to prevent water outside the vessel body from entering into the vessel body through the connector duct.

In a preferred embodiment of the present invention, the turned-up portion may include a water drain hole that opens downwardly.

According to this preferred embodiment, even if water outside the vessel body enters into the connector duct, this water is discharged outwardly from the connector duct and from the water extracting hole in the turned-up portion, and therefore it is possible to prevent water from collecting in the connector duct.

In a preferred embodiment of the present invention, the vessel may include a flange that projects from a periphery of the air intake port in the air intake box.

According to this preferred embodiment, it is possible for the flange to reduce or prevent hot air around the engine from entering the air intake port of the air intake box. This makes it possible to further reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the air intake duct includes an inner end disposed in the vessel body, and is disposed so as to take air into the inner end from the outer end. On the other hand, the guide duct is connected to the air intake port of the air intake box, and is disposed apart from the air intake duct. Additionally, the guide duct includes an intake port that takes in air that has been taken into the vessel body by the air intake duct.

According to this preferred embodiment, air taken in from outside the vessel body by the air intake duct flows into a region outside the air intake duct in the vessel body from the inner end of the air intake duct. That air is taken into the guide duct from the intake port of the guide duct, and is guided to the air intake port of the air intake box. The opening of the guide duct is connected to the air intake port of the air intake box, and therefore air that has been taken in from outside the vessel body and that has reached the inner end of the air intake duct is taken into the guide duct, and then reaches the air intake port without being exposed to hot air generated by the heat of the engine, and is supplied to the engine from the air intake box. Therefore, it is possible to further restrain the temperature of intake air of the engine from being raised.

In a preferred embodiment of the present invention, the intake port may be disposed at a lower position than a combustion chamber of the engine.

Cold air is liable to gather in a region below the combustion chamber that is a heat source of the engine, and therefore this region is lower in temperature than the surroundings of the combustion chamber. Therefore, air that has been taken in from outside the vessel body and that has reached the region reaches the air intake box from the intake port through the inside of the guide duct without being influenced by the heat of the engine, and is then supplied to the engine. As a result, it is possible to further prevent the temperature of intake air of the engine from being raised.

In a preferred embodiment of the present invention, the vessel may include a flange that projects from a periphery of the intake port in the guide duct.

According to this preferred embodiment, it is possible for the flange to reduce or prevent hot air around the engine from entering the intake port of the guide duct. This makes it possible to further reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the air intake duct may include an inner end disposed in the vessel body, and may be disposed so as to take air into the inner end from the outer end. Additionally, the guide duct may be spaced apart from the air intake box and from the air intake duct between the air intake box and the inner end.

According to this preferred embodiment, the guide duct, the air intake box, and the air intake duct are provided independently of each other, and therefore the degree of freedom in designing and disposing these components is increased.

In a preferred embodiment of the present invention, the vessel may include a fuel tank that is disposed at a more forward position than the air intake box in the vessel body and that stores fuel for the engine, and the guide duct may be disposed at a higher position than the fuel tank.

According to this preferred embodiment, the guide duct is drawn around toward a higher position than the fuel tank in the vessel body, and this makes it possible to bring the opening of the guide duct close to the air intake port of the air intake box. Therefore, air that has been taken in from outside the vessel body and that has reached the opening through the inside of the guide duct reaches the air intake port without being influenced by hot air in the vessel body, and is supplied to the engine from the air intake box, and therefore it is possible to further reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the vessel may include a heat shield that thermally shields a space between a first region where the engine is disposed in the vessel body and a second region where the air intake box and the opening are disposed in the vessel body.

According to this preferred embodiment, it is possible for the heat shield to reduce or prevent air that has been taken in from outside the vessel body and that has reached the opening through the inside of the guide duct from entering the first region and from being heated by the heat of the engine. Additionally, the heat shield makes it possible to reduce or prevent the hot air of the first region from entering the second region, and therefore it is possible to reduce or prevent an increase in temperature of the second region. Therefore, air that has reached the opening of the guide duct reaches the air intake port without being influenced by heat generated by the engine, and is supplied to the engine from the air intake box. As a result, it is possible to further reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the vessel may include a heat insulator with which the air intake box is covered.

According to this preferred embodiment, the air intake box is insulated from ambient hot air by the heat insulator, and therefore it is possible to reduce or prevent the temperature of air supplied to the engine from being increased in the air intake box. This makes it possible to further reduce or prevent the temperature of intake air of the engine from being increased.

In a preferred embodiment of the present invention, the vessel may be a jet propulsion watercraft including a jet pump that generates a jet propulsion force by sucking in and jetting out water by a driving force of the engine.

According to this preferred embodiment, in the jet propulsion watercraft, it is possible to reduce or prevent the temperature of intake air of the engine from being increased. As a result, it is possible to reduce or prevent a reduction in the output of the engine, and therefore it is possible to obtain a large propulsive force.

The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of a vessel according to a preferred embodiment of the present invention.

FIG. **2** is a front view of an engine and an air intake box, both of which are included in the vessel.

FIG. **3** is a side view of the engine and the air intake box.

FIG. **4** is a side view of the engine and an air intake structure according to a first example of a preferred embodiment of the present invention.

FIG. **5** is a side view of the engine and an air intake structure according to a second example of a preferred embodiment of the present invention.

FIG. **6** is a front view of the air intake structure according to the first example or the second example of a preferred embodiment of the present invention.

FIG. **7** is a perspective view of the air intake box.

FIG. **8** is a side view of the engine and an air intake structure according to a third example of a preferred embodiment of the present invention.

FIG. **9** is a side view of the engine and an air intake structure according to a fourth example a preferred embodiment of the present invention.

FIG. **10** is a side view of the engine and an air intake structure according to a fifth example of a preferred embodiment of the present invention.

FIG. **11** is a side view of the engine and an air intake structure according to a sixth example of a preferred embodiment of the present invention.

FIG. **12** is a side view of the engine and an air intake structure according to a seventh example of a preferred embodiment of the present invention.

FIG. **13** is a schematic view of a vessel according to another preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be hereinafter described in detail with reference to the accompanying drawings.

First Preferred Embodiment

FIG. **1** is a schematic view of a vessel **1** according to a preferred embodiment of the present invention. A left-right direction in FIG. **1** is a front-rear direction of the vessel **1**. A right side in FIG. **1** is a front side of the vessel **1**. In the following description, the left-right direction of the vessel **1** is defined based on when looking toward the front side of the vessel **1**. In other words, a near side in the direction perpendicular to the sheet of FIG. **1** is the right side of the vessel **1**, whereas a far side in the direction perpendicular to the sheet of FIG. **1** is the left side of the vessel **1**.

The vessel **1** includes a vessel body **2**, an engine **3**, and a fuel tank **4** both of which are contained in the vessel body **2**. The vessel body **2** includes a hull **5** defining a vessel bottom and a deck **6** disposed above the hull **5**, and extends in the front-rear direction. An internal space **2**A is defined inside the vessel body **2**. The internal space **2**A is defined by the hull **5** and the deck **6** so as to be contained therebetween in the up-down direction, and extends in the front-rear direction in the same way as the vessel body **2**. The engine **3** is disposed at a location between the ends of the internal space **2**A in the front-rear direction. The engine **3** is preferably an internal combustion engine including a crankshaft (not shown) that rotates around a crankshaft axis (not shown) extending in the front-rear direction. The fuel tank **4** is disposed at a more forward position than the engine **3** in the internal space **2**A. Fuel for the engine **3** is stored in the fuel tank **4**, and the engine **3** and the fuel tank **4** are connected together through a fuel supply pipe (not shown). The fuel in the fuel tank **4** is supplied to the engine **3** by the fuel supply pipe.

The vessel **1** in the present preferred embodiment is preferably a jet propulsion watercraft, for example. The vessel **1** additionally includes a seat **9** on which a crew member sits, a steering handle **10** operated rightwardly and leftwardly by the crew member, and a jet pump **12** attached to a rear portion of the vessel body **2**.

The seat **9** and the steering handle **10** are disposed at a central portion of the deck **6** in the left-right direction. An opening **6**A that is open upwardly is provided at an upper portion of the deck **6**. The opening **6**A is blocked from above by the seat **9** in an ordinary state. When the inside of the vessel body **2** undergoes maintenance, a user or a maintenance operator opens the opening **6**A by detaching the seat **9**, and accesses the inside of the vessel body **2** from the opening **6**A. The engine **3** contained in the vessel body **2** is located below the opening **6**A.

The steering handle **10** is disposed at a more forward position than the seat **9**. A throttle lever **13** is attached to a right end of the steering handle **10**, and a driving force of the engine **3** is adjusted by the operation of the throttle lever **13** by the crew member. A side-view mirror **11** that allows the crew member to see rearwardly is disposed in a more forward region than the steering handle **10** in an upper surface of the deck **6**.

The jet pump **12** is disposed at a more rearward position than the engine **3**. The jet pump **12** sucks water thereinto from the vessel bottom by the driving force of the engine **3**, and jets it rearwardly from the vessel body **2**. As a result, the jet pump **12** generates a propulsive force to propel the vessel **1**. In detail, the jet pump **12** includes a water intake port **14** through which water of the vessel body **2** is sucked in, a water outlet port **15** through which water sucked in from the water intake port **14** is jetted rearwardly, and a flow passage **16** through which water sucked in through the water intake port **14** is guided to the water outlet port **15**. The jet pump **12** additionally includes a drive shaft **17** that extends in the front-rear direction, an impeller **18** and a stationary blade **19** both of which are disposed in the flow passage **16**, a nozzle **20**, and a deflector **21** that rightwardly and leftwardly deflects a direction in which water is jetted to the rear side from the nozzle **20**.

The water intake port **14** is open in the vessel bottom, and the water outlet port **15** is open rearwardly behind the water intake port **14**. A front end of the drive shaft **17** is disposed in the vessel body **2**, and is connected to a crankshaft (not shown) of the engine **3** through a joint **22** or the like. A rear end of the drive shaft **17** is disposed in the flow passage **16**, and is connected to the impeller **18**. The stationary blade **19** is disposed behind the impeller **18**, and the nozzle **20** is disposed behind the stationary blade **19**. The stationary blade **19** and the nozzle **20** are fixed to the flow passage **16**.

The impeller **18** is rotatable around a central axis of the drive shaft **17** in the flow passage **16**. The impeller **18** is rotationally driven by the engine **3** around the central axis of the drive shaft **17** together with the drive shaft **17**. When the impeller **18** is rotationally driven, water outside the vessel body **2** is sucked into the flow passage **16** from the water intake port **14**, and is sent to the stationary blade **19** from the impeller **18**. Water that has been sent by the impeller **18** passes through the stationary blade **19**, and, as a result, water-flow torsion caused by the rotation of the impeller **18** is reduced, and a water flow is straightened. Therefore, water that has been straightened is sent to the nozzle **20** from the stationary blade **19**. The nozzle **20** preferably has a cylindrical shape extending in the front-rear direction, and the water outlet port **15** is located in a rear end of the nozzle **20**. Therefore, water that has been sent to the nozzle **20** is jetted rearwardly from the water outlet port **15** of the rear end of the nozzle **20**.

The deflector **21** extends rearwardly from the nozzle **20**. The deflector **21** is connected to the nozzle **20** so as to be rotatable rightwardly and leftwardly around a deflector axis **21**A extending in the up-down direction. The deflector **21** is hollow. The water outlet port **15** of the nozzle **20** is disposed in the deflector **21**. The deflector **21** includes a jet port **23** that opens rearwardly. The jet port **23** is disposed behind the water outlet port **15**. Water that has been jetted rearwardly from the water outlet port **15** passes through the inside of the deflector **21**, and is jetted rearwardly from the jet port **23**. The deflector **21** turns rightwardly and leftwardly in accordance with the operation of the steering handle **10**. As a result, the direction of water jetted from the jet pump **12** is changed rightwardly and leftwardly by the operation of the steering handle **10**, and therefore the vessel **1** is steered.

The vessel **1** additionally includes an air intake structure **30** to supply air outside the vessel body **2** to the engine **3**. The air intake structure **30** is disposed in the vessel body **2**.

The air intake structure **30** includes an air intake box **31**, an air intake duct **32**, and a guide duct **33**.

FIG. **2** is a front view of the engine **3** and the air intake box **31**. The air intake box **31** is, for example, made of a resinous material and is hollow. The air intake box **31** includes a built-in filter **34** to purify air. An air intake port **31**A to take air around the air intake box **31** into the air intake box **31** is located at an upper end of a front surface **31**B of the air intake box **31**. The air intake port **31**A is slender and extends in the left-right direction, and leads to the inside of the air intake box **31**. A plate-shaped partition **35** that is thin in the left-right direction may be provided at a location between the ends of the air intake port **31**A in the left-right direction. Air taken into the air intake box **31** from the air intake port **31**A is purified by the filter **34**.

FIG. **3** is a right side view of the engine **3** and the air intake box **31**. The air intake box **31** is attached to the engine **3** from the front, and is fixed to the engine **3** by a fastening member **36** such as a bolt (see also FIG. **2**). The air intake box **31** in this state is disposed at a more rearward position than the fuel tank **4** (see FIG. **1**). An air intake pipe **37** made of a flexible material, such as rubber or resin, extends, for example, rightwardly from a right surface **31**C of the air intake box **31**, and extends rearwardly in a curved manner. In relation to the air intake pipe **37**, a throttle body **38** to adjust the amount of air supplied to the engine **3** is disposed at a right surface of the engine **3**, and a rear end of the air intake pipe **37** is connected to the throttle body **38**. Therefore, air that has been taken in from the air intake port **31**A and that has been purified by the filter **34** in the air intake box **31** passes through the air intake pipe **37** and is supplied to the engine **3** through the throttle body **38**.

With reference to FIG. **1**, the air intake duct **32** and the guide duct **33** each preferably have the shape of a tube and made of a flexible material. In relation to the air intake duct **32**, a vent hole **6**B is located at a more forward position than the steering handle **10** in the upper surface of the deck **6**. The vent hole **6**B in the present preferred embodiment preferably includes a pair of vent holes, and these vent holes **6**B are arranged side by side in the left-right direction so as to be symmetrical with respect to the center of the vessel body **2** in the left-right direction. The air intake duct **32** includes an outer end **32**A connected to either of the pair of vent holes **6**B (in the present preferred embodiment, right vent hole **6**B) in the deck **6**, and is drawn around in the vessel body **2** from the outer end **32**A. An entrance **32**B that leads the inside of the air intake duct **32** from the vent hole **6**B to the outside of the vessel body **2** is provided at an upper end of the outer end **32**A. The guide duct **33** extends rearwardly toward the air intake box **31**. An opening **33**A opposing the air intake port **31**A of the air intake box **31** from the front is provided at a rear end of the guide duct **33**.

The following first to seventh examples are variations of the configuration of the air intake structure **30**. FIG. **4** and FIG. **5** are right side views of air intake structures **30** according to the first and second examples, respectively. FIG. **6** is a front view of the air intake structures **30** according to the first and second examples. FIG. **7** is a perspective view of the air intake box **31** seen from the front. FIG. **8** to FIG. **12** are right side views of air intake structures **30** according to the third to seventh examples, respectively. The air intake structure **30** according to the first example is shown in FIG. **1**.

In the first example shown in FIG. **4**, the air intake duct **32** and the guide duct **33** are each a portion of a single connector duct **40**. Therefore, the number of components is reduced. In the connector duct **40**, an upstream portion containing the outer end **32**A is the air intake duct **32**, and a downstream portion where the opening **33**A is provided is the guide duct **33**. The connector duct **40** is fixed to the deck **6** in the vent hole **6**B, and is drawn around in the vessel body **2** so as to oppose the air intake port **31**A through the inside of the vessel body **2** from the outer end **32**A. The opening **33**A is disposed at substantially the same position as the air intake port **31**A in the up-down direction, and is directed from the front toward the air intake port **31**A with a gap therebetween.

The connector duct **40** includes an integral upper portion **40**A disposed at a higher position than the fuel tank **4** and an integral turned-up portion **40**B that extends downwardly from the upper portion **40**A and then turns upwardly. The turned-up portion **40**B is located at a higher position than a water surface around the vessel body **2** when the vessel **1** is overturned so as to reverse the up-down direction of the vessel body **2**. As a result, water outside the vessel body **2** cannot pass through the turned-up portion **40**B even if this water infiltrates into the connector duct **40** from the vent hole **6**B. This makes it possible to prevent water outside the vessel body **2** from infiltrating into the vessel body **2** through the connector duct **40**.

In the first example, the turned-up portion **40**B is disposed at a more forward position than the fuel tank **4**. In the second example shown in FIG. **5**, which is a modification of the first example, the turned-up portion **40**B may be disposed between the air intake box **31** and the fuel tank **4**. In each air intake structure **30** of the first and second examples, a water drain hole **40**C that is open downwardly is located in a lower end of the turned-up portion **40**B. Even if water outside the vessel body **2** infiltrates into the connector duct **40**, this water is discharged outwardly from the connector duct **40** and from the water drain hole **40**C in the turned-up portion **40**B. Therefore, it is possible to prevent water from collecting in the connector duct **40**.

As shown in FIG. **6**, in both the first example and the second example, the connector duct **40** includes a first halfway portion **40**D that extends downwardly from the outer end **32**A and a second halfway portion **40**E that extends either in the left direction or in the right direction (in FIG. **6**, in the right direction) from a lower end of the first halfway portion **40**D and that is connected to the turned-up portion **40**B. In the first example, the turned-up portion **40**B is positioned between the upper portion **40**A and the second halfway portion **40**E (see FIG. **4**), and, in the second example, the upper portion **40**A is also the second halfway portion **40**E (see FIG. **5**).

The vessel **1** includes an exhaust duct **45** that is connected to another vent hole **6**B (in the present preferred embodiment, vent hole **6**B on the left side) that is different from the vent hole **6**B connected to the outer end **32**A and that is drawn around in the vessel body **2**. The exhaust duct **45** discharges air in the vessel body **2** outwardly from the vessel body **2**. The exhaust duct **45** preferably has a shape that is different from that of the connector duct **40**, for example, so as to be laterally symmetrically with the connector duct **40**, and overlaps the connector duct **40** in a front view. The length of the connector duct **40** may differ from that of the exhaust duct **45**. As thus described, the vessel **1** includes the two ducts **40** and **45** that differ from each other in shape.

Air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B, and is then guided to the opening **33**A by the guide duct **33** (see the dashed arrows in FIG. **4** and FIG. **5**). The opening **33**A faces the air intake port **31**A of the air intake box **31** and so as to be located near the air intake port **31**A, and therefore air that has reached the opening **33**A swiftly flows into the air intake port **31**A, and is taken into the air intake box **31**, and is supplied to the engine **3**. As thus described, air outside the vessel body **2** reaches the air intake port **31**A of the air intake box **31** without being exposed to hot air generated by the heat of the engine **3** in the vessel body **2** as much as possible, and hence is supplied to the engine **3** in a low-temperature state that is substantially no different from the outside air temperature. As a result, it is possible to reduce or prevent the temperature of the intake air of the engine **3** from being increased even if the vessel **1** is being used in a high-temperature environment such as summer time. These effects are also be obtained in the third to seventh examples described later.

As shown in FIG. **7**, the air intake box **31** may be provided with a flange **46** that projects from the periphery of the air intake port **31**A. The flange **46** preferably has the shape of a plate and is disposed so that a thickness direction thereof corresponds to the front-rear direction, and surrounds the air intake port **31**A. This makes it possible for the flange **46** to reduce or prevent hot air around the engine **3** from flowing forwardly and from entering the air intake port **31**A of the air intake box **31**. Therefore, it is possible to further reduce or prevent the temperature of intake air of the engine **3** from being increased.

The whole area of the outer surface including the front surface **31**B and the right surface **31**C of the air intake box **31** may be covered with a heat insulator **47** (which is shown by dots in FIG. **7** for clarification). In this case, the air intake box **31** is insulated from the surrounding ambient hot air by the heat insulator **47**, and therefore it is possible to reduce or prevent the temperature of air supplied to the engine **3** from being increased in the air intake box **31**. This makes it possible to further reduce or prevent the temperature of intake air of the engine **3** from being increased. The heat insulator **47** is applicable not only to the first and second examples but also to the third to seventh examples described below.

The vessel **1** may include a heat shield **48**. The heat shield **48** is made of, for example, resin, and preferably has the shape of a sheet. In the present preferred embodiment, the heat shield **48** is disposed along a boundary between the air intake box **31** and the engine **3** as shown in FIG. **4** and FIG. **5**. A lower end **48**A of the heat shield **48** is connected to the hull **5**, and an upper end **48**B of the heat shield **48** is connected to the deck **6**. As a result, the heat shield **48** partitions the internal space **2**A of the vessel body **2** into a first region **2**B that is an engine room where which the engine **3** is disposed and a second region **2**C where the air intake box **31** and the opening **33**A are disposed in the internal space **2**A, and thermally shields the space between the first region **2**B and the second region **2**C.

Therefore, it is possible to prevent air that has been taken in from outside the vessel body **2** and that has reached the opening **33**A through the inside of the guide duct **33** from entering the first region **2**B. This makes it possible to reduce or prevent air taken in from outside the vessel body **2** from being heated by the heat of the engine **3** and then reaching the air intake port **31**A of the air intake box **31**. Additionally, the heat shield **48** makes it possible to prevent the hot air of the first region **2**B from entering the second region **2**C, and therefore it is possible to reduce or prevent an increase in temperature of the second region **2**C. Therefore, air that has reached the opening **33**A reaches the air intake port **31**A without being influenced by heat in the first region **2**B and the second region **2**C as much as possible, and is supplied to the engine **3** from the air intake box **31**.

Even only the existence of the heat shield **48** makes it possible to reduce or prevent the temperature of intake air of the engine **3** from being increased. In addition, if the heat shield **48** is applied to the first to seventh examples, it is possible to further reduce or prevent the temperature of intake air of the engine **3** from being increased.

The third example shown in FIG. **8** is a modification of the first and second examples. An attachment **49** is provided at a downstream end of the connector duct **40**. The attachment **49** includes, for example, a box-shaped base **49**A and a circular cylindrical exit portion **49**B that protrudes upwardly from the base **49**A. The internal space of the base **49**A and the internal space of the exit portion **49**B communicate with each other, and define the internal space of the downstream end of the connector duct **40**. The exit portion **49**B is preferably tapered such that the cross-sectional area of its flow passage becomes larger as it extends upwardly. The opening **33**A is located at an upper end of the exit portion **49**B, and opposes the air intake port **31**A of the air intake box **31** from below. The downstream end of the connector duct **40** includes the turned-up portion **40**B, which extends downwardly from the upper portion **40**A and is then upwardly turned toward the opening **33**A by the attachment **49**. The attachment **49** makes it possible to freely set the position of the opening **33**A.

In the third example, air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B, and is then guided to the opening **33**A by the guide duct **33** and the attachment **49**, and is discharged upwardly from the opening **33**A (see the dashed arrows in FIG. **8**). The opening **33**A is directed toward the air intake port **31**A of the air intake box **31**, and therefore air that has reached the opening **33**A reaches the air intake port **31**A immediately, and is taken into the air intake box **31** and supplied to the engine **3**.

In the fourth example shown in FIG. **9**, unlike the first to third examples, the air intake duct **32** and the guide duct **33** are preferably not integral with each other. The air intake duct **32** includes an inner end **32**C located on the side opposite to the outer end **32**A, and takes air into the inner end **32**C from the outer end **32**A. The inner end **32**C includes an outlet **32**D that allows air taken into the inner end **32**C from the outer end **32**A to flow outside the air intake duct **32** (i.e., flow to a region outside the air intake duct **32** in the internal space **2**A). The outlet **32**D is open to the internal space **2**A. The inner end **32**C is disposed in front of the fuel tank **4**, and the outlet **32**D is directed downwardly so as to oppose an inner bottom surface of the hull **5**. A front end of the guide duct **33** includes an intake port **33**B that takes in air that has been taken into the vessel body **2** by the air intake duct **32**. In a space above the fuel tank **4**, the guide duct **33** extends rearwardly from the intake port **33**B to the opening **33**A. The intake port **33**B is not connected to the inner end **32**C, and is adjacent to the inner end **32**C from behind. Therefore, the guide duct **33** is spaced apart from the air intake duct **32**.

A box-shaped attachment **50** is disposed between the front surface **31**B of the air intake box **31** and a rear end of the guide duct **33**, and is connected to the air intake box **31** and to the guide duct **33**. Therefore, the guide duct **33** is connected to the air intake box **31** through the attachment **50**. The internal space of the attachment **50** leads to the internal space of the rear end of the guide duct **33** from behind, and leads to the air intake port **31**A of the air intake box **31** from the front. The opening **33**A of the guide duct **33** opposes the air intake port **31**A from the front through the internal space of the attachment **50**.

In the fourth example, air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B, and then flows from the outlet **32**D to a region in front of the fuel tank **4** in the vessel body **2** (see the arrow having the alternate long and short dashed line in FIG. **9**). Air in this region is taken into the guide duct **33** from the intake port **33**B, and is guided to the opening **33**A, and is guided from the opening **33**A to the air intake port **31**A through the inside of the attachment **50** (see the arrow having the alternate long and two short dashed line in FIG. **9**). As a result, air that has been taken in from outside the vessel body **2** and that has reached the inner end **32**C of the air intake duct **32** is taken into the guide duct **33**, and then reaches the air intake port **31**A without being exposed to hot air generated by the heat of the engine **3**, and is supplied to the engine **3**. As a result, it is possible to reduce or prevent the temperature of intake air of the engine **3** from being increased.

The length of the guide duct **33** is able to be changed to have an arbitrary length. If the guide duct **33** is lengthened so that the intake port **33**B becomes close to the inner end **32**C of the air intake duct **32**, it is possible to efficiently take in air, which has been taken in from outside the vessel body **2** by the air intake duct **32**, into the intake port **33**B and supply it to the engine **3**.

The fifth example shown in FIG. **10** is a modification of the fourth example. In the fifth example, the inner end **32**C of the air intake duct **32** is preferably disposed between the fuel tank **4** and the air intake box **31** in the internal space **2**A of the vessel body **2**. The attachment **50** (see FIG. **9**) may be excluded, and the opening **33**A of the guide duct **33** is preferably connected directly to the air intake port **31**A of the air intake box **31**.

In the fifth example, air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B of the outer end **32**A, and then flows into a region between the fuel tank **4** and the air intake box **31** in the vessel body **2** from the outlet **32**D of the inner end **32**C of the air intake duct **32** (see the arrow having the alternate long and short dashed line in FIG. **10**). Air in this region is taken into the guide duct **33** from the intake port **33**B, and is guided to the opening **33**A (see the arrow having the alternate long and two short dashed line in FIG. **10**). The air intake port **31**A of the air intake box **31** receives air that has reached the opening **33**A, and therefore air that has reached the opening **33**A is immediately taken into the air intake box **31** from the air intake port **31**A, and is supplied to the engine **3** as described above.

The guide duct **33** is preferably provided with a flange **51** that projects from the periphery of the intake port **33**B. The flange **51** preferably has the shape of a plate and is disposed so that a thickness direction thereof corresponds to the front-rear direction, and surrounds the intake port **33**B. In this case, it is possible for the flange **51** to reduce or prevent hot air around the engine **3** from flowing forwardly and from entering the intake port **33**B of the guide duct **33**. This makes it possible to further reduce or prevent the temperature of intake air of the engine **3** from being increased.

The sixth example shown in FIG. **11** is a modification of the fifth example. In this example, the guide duct **33** includes a first duct **33**C that is disposed between the fuel tank **4** and the air intake box **31** and that extends in the up-down direction. The guide duct **33** additionally includes an integral second duct **33**D that extends rearwardly from an upper end of the first duct **33**C and that is connected to the air intake port **31**A. The intake port **33**B is located at a lower end of the first duct **33**C, and opens downwardly. The intake port **33**B is disposed below the combustion chamber **3**A which is disposed at the upper portion of the engine **3**. The opening **33**A is located at a rear end of the second duct **33**D, and faces the air intake port **31**A from the front.

In the sixth example, air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B, and then flows from the outlet **32**D into a region between the fuel tank **4** and the air intake box **31** in the vessel body **2** (see the arrow having the alternate long and short dashed line in FIG. **11**). Air in this region is taken into the guide duct **33** from the intake port **33**B, and flows through the first duct **33**C and the second duct **33**D, in this order, and is guided to the opening **33**A (see the arrow having the alternate long and two short dashed line in FIG. **11**). The opening **33**A is directed to the air intake port **31**A of the air intake box **31**, and therefore air that has reached the opening **33**A is immediately taken into the air intake box **31** from the air intake port **31**A, and is supplied to the engine **3**.

Cold air is likely to collect in a region below the combustion chamber **3**A that is a heat source of the engine **3**, and therefore this region is lower in temperature than the surroundings of the combustion chamber **3**A. Therefore, air that has been taken in from outside the vessel body **2** and that has reached this region reaches the air intake box **31** from the intake port **33**B through the inside of the guide duct **33** without being influenced by the heat of the engine **3** as much as possible.

In the seventh example shown in FIG. **12**, unlike the first to sixth examples, the guide duct **33** is spaced apart from each of the air intake box **31** and the air intake duct **32** between the air intake box **31** and the inner end **32**C of the air intake duct **32**. Therefore, the guide duct **33**, the air intake box **31**, and the air intake duct **32** are independent of each other, and therefore the degree of freedom in designing and disposing these components is high. The inner end **32**C is disposed in front of the fuel tank **4** in the internal space **2**A of the vessel body **2**. The guide duct **33** includes an integral upper portion **33**E that is disposed at a higher position than the fuel tank **4** and that extends in the front-rear direction and an integral front portion **33**F that bends from a front end of the upper portion **33**E and that extends downwardly and that is disposed in front of the fuel tank **4**. The front portion **33**F may be excluded. The opening **33**A is located at a rear end of the upper portion **33**E. A box-shaped attachment **52** is connected to a rear end of the upper portion **33**E. The attachment **52** faces the air intake port **31**A of the air intake box **31** from the front with an interval of, for example, about 10 mm therebetween. A rear surface of the attachment **52** is open, and the opening **33**A of the guide duct **33** opposes the air intake port **31**A from the front through the internal space of the attachment **52**.

In the seventh example, air outside the vessel body **2** is taken into the air intake duct **32** from the entrance **32**B, and then flows from the outlet **32**D into a region in front of the fuel tank **4** in the vessel body **2** (see the arrow having the alternate long and short dashed line in FIG. **12**). Air in this region is taken into the guide duct **33** from the intake port **33**B, and is guided to the opening **33**A (see the arrow having the alternate long and two short dashed line in FIG. **12**), and is guided to the air intake port **31**A through the attachment **52**.

The guide duct **33** including the upper portion **33**E is drawn around toward a higher position than the fuel tank **4** in the vessel body **2**. This makes it possible to bring the opening **33**A of the guide duct **33** close to the air intake port **31**A of the air intake box **31**. Therefore, air that has reached the opening **33**A flows into the air intake box **31** from the air intake port **31**A, and is supplied to the engine **3** without being influenced by hot air in the vessel body **2** as much as possible. Therefore, it is possible to reduce or prevent the temperature of intake air of the engine **3** from being increased.

Other Preferred Embodiments

Although preferred embodiments of the present invention have been described above, the present invention is not restricted to the contents of the preferred embodiments and various modifications are possible within the scope of the present invention.

For example, if the engine **3** is disposed in the vessel body **2**, the vessel **1** may include exclude the jet pump **12** as a propulsive-force generating mechanism. A screw that is connected to a crankshaft (not shown) of the engine **3** and that is disposed outside the vessel body **2** may be used as the propulsive-force generating mechanism.

FIG. **13** is a schematic view of a vessel **1** according to another preferred embodiment. Another example of the vessel **1** is a jet boat **1**A shown in FIG. **13**. In FIG. **13**, the same numerals are given to components that are equivalent in function to the components described above, and a detailed description of those components is omitted. The vessel body **2** of the jet boat **1**A includes the hull **5** and the deck **6** disposed above the hull **5**. A cockpit **60** is provided at a central or substantially central portion of the deck **6** in the front-rear direction. For example, a seat **9**A for a vessel operator and the steering handle **10** are disposed in a front region in the cockpit **60**, and a passenger seat **9**B is disposed in a rear region in the cockpit **60**. The deck **6** includes a projection **61** that protrudes upwardly and that may be used as a portion of a backrest of the passenger seat **9**B. The projection **61** is hollow, and the internal space of the projection **61** includes a portion of the internal space **2**A of the vessel body **2**. The projection **61** includes a vent hole **6**B as described above.

The engine **3** is disposed in a region deviated rearwardly in the internal space **2**A of the vessel body **2**, and, for example, is positioned below the projection **61**. The jet pump **12** is disposed at the rear portion of the vessel body **2**, and generates a propulsive force by the driving force of the engine **3**. The fuel tank **4** is disposed at a more forward position than the engine **3** in the internal space **2**A.

The air intake structure **30** is also included in the jet boat **1**A. In the air intake structure **30** in this case, the air intake box **31** is attached to the engine **3** from the front in a region between the engine **3** and the fuel tank **4** in the internal space **2**A. The outer end **32**A of the air intake duct **32** is disposed in the projection **61** of the deck **6**, and the entrance **32**B of the outer end **32**A is connected to the vent hole **6**B of the projection **61**. The air intake duct **32** is drawn around forwardly from the outer end **32**A in a region higher than the engine **3** in the internal space **2**A. The guide duct **33** extends forwardly through the upper space above the air intake box **31**, and bends downwardly in the internal space **2**A. The opening **33**A disposed at the lower end of the guide duct **33** opposes the air intake port **31**A located at the front surface **31**B of the air intake box **31** from the front.

In the jet boat **1**A, air outside the vessel body **2** is taken in by the air intake duct **32**, and is then guided to the opening **33**A by the guide duct **33** (see the dashed arrow in FIG. **13**). Air that has been guided to the opening **33**A swiftly flows into the air intake port **31**A, and is taken into the air intake box **31** and supplied to the engine **3**. Therefore, likewise, in the jet boat **1**A, air outside the vessel body **2** reaches the air intake port **31**A of the air intake box **31** without being exposed to hot air generated by the heat of the engine **3**, and hence is supplied to the engine **3** in a low-temperature state that is substantially no different from the outside air temperature.

Likewise, in the air intake structure **30** of the jet boat **1**A, the air intake duct **32** and the guide duct **33** are preferably integral with each other as the connector duct **40** in the same way as in the first and second examples. The attachment **49** (see FIG. **8**) of the third example may be used. As in the fourth to sixth examples, the guide duct **33** may be spaced apart from the air intake duct **32**, and, in this case, the attachment **50** (see FIG. **9**) may be used. As in the seventh example, the guide duct **33** may be spaced apart from each of the air intake box **31** and the air intake duct **32**. Additionally, the flange **46**, the heat insulator **47**, and the heat shield **48** (see FIG. **7**) may be used. In the jet boat **1**A, unlike that of FIG. **13**, the air intake duct **32** and the guide duct **33** may have same layout as in FIGS. **1** to **12** if the outer end **32**A of the air intake duct **32** is disposed at a more forward position than the engine **3**.

It is to be understood that features of two or more of the various preferred embodiments described above may be combined.

The present application claims priority to Japanese Patent Application No. 2016-164977 filed on Aug. 25, 2016 in the Japan Patent Office, and the entire disclosure of which is incorporated herein by reference in its entirety.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, thus, is to be determined solely by the following claims.

What is claimed is:

1. A vessel comprising:

a vessel body including a hull and a deck, the hull defining a vessel bottom, and the deck being disposed above the hull;

an engine contained in the vessel body;

an air intake box attached to the engine and including an air intake port and that supplies air taken in from the air intake port to the engine;

an air intake duct including an outer end connected to the deck; and

a guide duct including an opening that opposes the air intake port and that guides air taken in from outside the vessel body by the air intake duct to the opening.

2. The vessel according to claim **1**, further comprising a connector duct that includes the air intake duct and the guide duct; wherein

the connector duct passes through an inside of the vessel body from the outer end and opposes the air intake port.

3. The vessel according to claim **2**, further comprising an exhaust duct; wherein

the connector duct and the exhaust duct differ from each other in shape.

4. The vessel according to claim **3**, further comprising a fuel tank disposed at a more forward position than the air intake box in the vessel body and that stores fuel for the engine; wherein

the connector duct includes an upper portion and a turned-up portion;

the upper portion is disposed at a higher position than the fuel tank; and

the turned-up portion is disposed at a more forward position than the fuel tank or disposed between the air intake box and the fuel tank, and the turned-up portion extends downwardly from the upper portion and then turns upwardly.

5. The vessel according to claim **4**, wherein the turned-up portion includes a water drain hole that opens downwardly.

6. The vessel according to claim **2**, further comprising a flange that projects from a periphery of the air intake port of the air intake box.

7. The vessel according to claim **1**, wherein the air intake duct includes an inner end disposed in the vessel body and takes air into the inner end from the outer end; and

the guide duct is connected to the air intake port of the air intake box, is spaced apart from the air intake duct, and includes an intake port that takes in air that has been taken into the vessel body by the air intake duct.

8. The vessel according to claim **7**, wherein the intake port is disposed at a lower position than a combustion chamber of the engine.

9. The vessel according to claim **7**, further comprising a flange that projects from a periphery of the intake port of the guide duct.

10. The vessel according to claim **1**, wherein the air intake duct includes an inner end disposed in the vessel body and that takes air into the inner end from the outer end; and

the guide duct is spaced apart from the air intake box and from the air intake duct between the air intake box and the inner end.

11. The vessel according to claim **7**, further comprising a fuel tank disposed at a more forward position than the air intake box in the vessel body and that stores fuel for the engine; wherein

the guide duct is disposed at a higher position than the fuel tank.

12. The vessel according to claim **1**, further comprising a heat shield that thermally shields a space between a first region where the engine is disposed in the vessel body and a second region where the air intake box and the opening are disposed in the vessel body.

13. The vessel according to claim **1**, further comprising a heat insulator with which the air intake box is covered.

14. The vessel according to claim **1**, wherein the vessel is a jet propulsion watercraft including a jet pump that generates a jet propulsion force by sucking in and jetting out water by a driving force of the engine.

15. The vessel according to claim **1**, wherein the opening opposes the air intake port so that the air in the guide duct flows from the opening into the air intake port.

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